Alexander Mladenov analyses the former Soviet Air Force view that the MiG-23MLD was an effective adversary for the F-15A, F-16A, F-4E and Kfir C.2 in the air superiority role.

MiG-23MLD vs Western Fighters

THE SOVIET AIR FORCE VIEW

ALTHOUGH ANY article about the MiG-23 must now be viewed from an historical perspective, retrospective analysis of the aircraft's capabilities nevertheless still has some relevance to the present day, even though the *Flogger* was retired from service in Russia, the CIS republics and Eastern Europe between 1997 and 2002. However, in those Third World countries which are considered to be hostile to the West, and still operating the type, it is considered capable of performing very effectively in the air-to-air role - perhaps with even better mission-capable rates than the early-series MiG-29s operated by those nations. As many as 30 interceptor *Floggers* were thought to have been maintained in combat-ready status by the Iraqi Air Force prior to Operation IRAOI FREEDOM and 60 more are in service with the Syrian Air Force (including more than 40 highly-modified MiG-23MLD *Flogger-K).* The Cuban Air Force has just under three dozen MiG-23MF F/ogger-6/MiG-23MLA *Flogger-G* on strength, while more than 40 *Flogger-Gs* continue to soldier on with the North Korean Air Force. Some of the countries on the 'rogue' list (i.e. North Korea, Syria) have skilled and determined *Flogger* pilots. To underestimate them and their aircraft would be foolish and, in the case of war, potentially dangerous.

Further *Flogger* Upgrades

In June 1982, the Syrian Air Force's rather orthodox Soviet-style air superiority/air defence doctrine, training and tactics proved ineffective against the Israeli Defence Force/Air Force (IDF/AF). Syrian losses between June 6 and June 11 - of fighters, fighter-bombers and helicopters - numbered around 85 (the actual figure was somewhere between 82 and 92, according to some sources), while Syria claimed to have shot down some 27 IDF/AF fixed- and rotary-wing aircraft, which is obviously untrue. On the other hand, Israeli denials that it lost any aircraft in air combat during the 1982 Lebanon war may be considered, to some extent, dubious. According to an authoritative article, *Early MiG-23s in Operational Service,* by Tom Cooper, who has researched the local conflicts of the 1960s-1980s (see *Air Enthusiast,* Vol 100, July-August 2002, p56-67), the Syrian fighter *Floggers* played only a secondary role in the conflict. Confirmed Syrian losses during the clashes over the Bekaa Valley between June 9 and 11 were four MiG-23MS *Flogger-Es* (the original *Flogger* interceptor variant for export to Middle East customers) and six MiG-23MF *Flogger-Bs,* their pilots claiming at least five enemy aircraft shot down. Most, if not all, of these kills cannot be confirmed by independent sources and thus must be regarded as less than reliable reports.

M1G-23MLD Pros and Cons

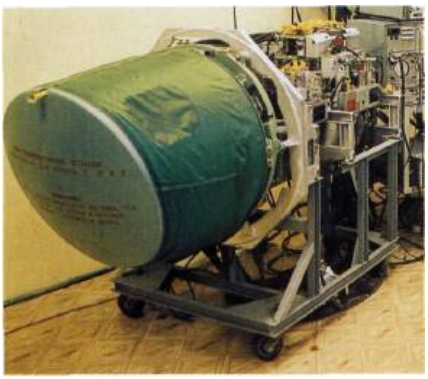
The Soviet Air Force's most significant post-Bekaa Valley undertaking was the accelerated upgrade to MiG-23MLD *Flogger-K* standard of the then huge VVS-FA MiG-23ML/MLA *Flogger-G* fleet (this variant was also known as *Izdyelie 23-18* in the internal designation system of the MiG Design Bureau). In the early 1980s, the MiG-23 formed the backbone of VVS *(Voenno-Vozdushniye Sili* - the Soviet Air Force) Frontal Aviation (FA) air defence/air superiority assets. No fewer than 1,100 MiG-23M/ML/MLAs were then in service with the Soviet front-line combat

Above: *A typical scene from the heyday of* Flogger *operations in East Germany, showing a squadron line-up of MiG-23MLDs at Altes Lager, with two MiG-23UB* Flogger-Bs *at the right-hand end of each group of six aircraft, whilst another* Flogger-B *can be seen returning to dispersal in the upper right of the picture. In the early 1980s, these interceptor variants of the* Flogger *were the most numerous fighter assets of the Soviet Air Force's tactical units (Frontal Aviation), with around 1,100 Examples deployed at bases in Central Europe and stretching across the Soviet Union to the Russian Far East.* TIEME FESTNER

units and more than 600 of them were used to equip at least 15 fighter regiments based in Central Europe. These regiments were considered to be the spearhead of Soviet air superiority assets in the Cold War era's most sensitive theatre of operations.

The *Flogger-K* upgrade package is known to have been completed prior to the Lebanon war and a total of 560 VVS MiG-23ML/MLAs were upgraded to the improved standard. Additionally, a total of 66 modified interceptors (in which only the avionics were upgraded) were said by Russian sources to have been newly-built between mid/late 1982 and December 1984.

Above: *The defection of a Syrian Air Force pilot to Israel in October 1989 in his MiG-23MLD(Export) gave the West an excellent opportunity to evaluate this variant of the* Flogger *at first hand. Here the aircraft (2786) Is seen shortly after landing at Megido, being made safe by Israeli ground personnel. The Syrian* Flogger *was subsequently used in an extensive series of comparison trials against all of the IDF/AF's fighter types, (in fact against all the types listed in the Soviet Aide-Memoire), and is now exhibited in the Israeli Air Force Museum,* VIA SHLOMO ALONI



Seen here on an avionics test bench, the Sapfir-23MLAE-2 Hiqhlark-lll *radar of the MiG-23MLD was modified from the earlier variants to incorporate a Pulse Doppler/Non-Coherent (i.e. probably medium PRF) mode, offering the capability for ultra low-level target detection, recommended for use over rough terrain or when a target uses chaff to evadeinterception.*

Above: *As can be seen on this* Flogger-K *at a Russian Air Force base in the 1990s, the* Hiqhlark-lll *radar is installed in the aircraft with the green environmental protection screen and radio-transparent antenna plate attached. The instruction at the bottom of the cover reads 'Before removal disconnect waveguide underneath protective cover'.*

Above: *The design of the MiG-23 as a pursuit interceptor, rather than as a 'dogfighter', is clearly evident in this frontal view of a Bulgarian Air Force* Flogger-G, *showing the pilot's limited rearward and downward field of view, resulting from the low-drag canopy, faired into the fuselage spine. The rather narrow field of view of the rear view mirror on the central canopy structure only partially compensates for this deficiency.*

ALL PHOTOS AUTHOR EXCEPT WHERE INDICATED

Known as the MiG-23MLD (Export) *(Izdelie 23-19* or the alternative designation *Izdelie 23-22),* these were exported only to Syria and Bulgaria - totalling 50 and 16 examples respectively. Interestingly, the NATO reporting name *Flogger-G* was retained as these aircraft were hardly distinguishable from the basic MiG-23ML/MLA. Unlike its export counterparts, the VVS-FA MiG-23MLD had a much-improved manoeuvring performance, thanks to a host of airframe and flight control system upgrades.

Westerners might find it interesting to read a 32-page Soviet Air Force supplementary air combat manual called *Aide-Memoire for the MiG-23 Pilot on Air Combat vs F-15A, F-I6A, F-4E and Kfir C.2,* published not long after the Bekaa Valley clashes. At that time both Soviet pilots and those from its client states were still trained mainly in the orthodox - some might say 'inflexible' - air intercept tactics originating from the 1960s, which were mastered to perfection during the MiG-21 era, from the early 1960s to the 1970s. In the 1970s and early 1980s, the Soviet Union and its client air arms flew the MiG-23M/ML/MLD in the same way as the MiG-21 - as a high-speed point interceptor closely guided and supported by the GCI. It took the Russians 12 years to exploit the *Flogger-G/K* as a true air superiority fighter.

The *Aide-Memoire for the MiG-23 Pilot on Air Combat vs F-15A, F-I6A, F-4E and Kfir C.2* refers to the MiG-23MLD(Export) version, powered by the R35-300 turbojet, rated at 28,700lb (127kN) in full afterburner, without the aerodynamics and flight control system improvements of the VVS-FA MIG-23MLDS. According to the manual, the aircraft's main parameters, defining its manoeuvring performance, turn out to be slightly better than the McDonnell Douglas F-4E Phantom II and definitely better than the IAI Kfir C.2. However, the **MiG-23MLD's** air combat performance, as quoted in the manual, is cited as definitely inferior to the McDonnell Douglas F-15A and General Dynamics F-16A. There are only a few areas within the MiG-23MLD's envelope where it could boast performance equal to, or slightly better than, the third-generation US fighters.

The manual's authors claim that in comparison with the F-4E (though whether they mean the slatted or non-slatted sub-version of the Phantom is not clear), the MiG-23MLD has superior sustained turn performance throughout the entire envelope, excluding the range between 377 and 540kts (700 and 1,000km/h) below 21,000ft (6,400m). It also has the edge over the Phantom II in zoom climb performance at all altitudes and speeds, excluding the true airspeed range between 485 and 647kts (900 and 1,200km/h) above 18,000ft (6,000m).

Compared with the F-15A, the MiG-23MLD's only notable advantage is in zoom climb performance at speeds above 620kts (1,150km/h). However, the manual asserts that compared with the F-16A, the Soviet swing-wing fighter produces a somewhat better sustained turn performance above 15,000ft (5,000m), at speeds close to the maximum, as well as better zoom climb performance at true airspeeds exceeding 590kts (1,100km/h). However, as comparative tests have shown, using the Syrian MiG-23MLD(Export) which defected to Israel in October 1989, the swing-wing fighter demonstrated, somewhat surprisingly, that it had better acceleration than the escorting F-16s. This would seem to indicate that in 'real world' conditions the MiG-23MLD would have a slight edge over the early F-16s in acceleration and energy manoeuvrability at true airspeeds above 485kts (900km/h).

The IAI Kfir C.2, as assessed in the manual, is said to be inferior to the MiG-23MLD in sustained turn performance at airspeeds above 540kts (1,000km/h), and in zoom climb performance at true airspeeds below 540kts (1,000km/h). However, at altitudes below 12,000ft (4,000m) the MiG-23MLD has the edge in energy manoeuvrability throughout the entire speed range.

Sensor and Self-Protection Considerations

According to the manual, the MiG-23MLD's N008E Sapfir-23MLAE-2 pulse radar has a performance superior to the Phantom's APQ-120, an approximately equal performance to the F-16A's AN/APG-66, and a distinctly inferior performance to the F-15A's AN/APG-63. (See *Table 2 and Figure T).*

The authors claim that airborne radar maximum detection range alone cannot grant any decisive tactical advantage in the non-sterile environment of 'real world' air combat. It is a well-known fact that fighter radar target detection and discrimination performance are, in general terms, somewhat limited by the relatively low resolution offered by a radar beam with an average width of between 2.5 and 3.5 degrees in azimuth and elevation. In addition, the generally low reliability of the electronic identification (EID) facilities of the early/mid 1980s is another factor which would prevent

enemy fighters from making full use of their superior Beyond Visual Range (BVR) capability. However, the manual notes that the F-16A and F-15A radars have a wide range of valuable close air combat modes with automatic target acquisition at close ranges (up to 6-10nm [10-18km]), with missile seeker heads slaved to the radar's line-of-sight for increased accuracy and reduced missile lock-on times.

Both the F-15A and F-16A pulse-Doppler (PD) radars are known to have problems with lock-on stability against targets flying below them which appear on the port or starboard beam, when in 'snap-down' mode. This particular shortcoming may be used to good effect by MiG-23 pilots to escape from attacks, since evading the AIM-7F Sparrow SARH (Semi-Active Radar Homing) missile launched by the F-15 could be easily achieved by carrying out high-g manoeuvring abeam the intercepting aircraft.

As a general rule, in operations over mountainous terrain, the performance of the early Sapfir-23 in the look-down/shoot down mode is noticeably degraded. However, the MLD's Sapfir-23MLAE-2 radar has a new and highly useful pulse-Doppler mode (Non-Coherent) with improved ultra-low-level target detection (useful for operations over rough terrain) reguiring a minimum target altitude of 160ft (50m). Whichever intercept profile is employed, the MiG-23MLD's look-down/shoot-down operations require heavy GCI support, and any attacks against fighter-size targets in such conditions should be mounted in tail-on aspect, where the radar's maximum detection range is said to be up to 13nm (25km) and tracking range up to 9nm (16km). The Spafir-23MLAE-2, featuring new look-down, passive jamming countermeasures and close air combat modes, demonstrated a moderate reliability in actual operational conditions, with Mean-Time-Between-Failures (MBTF) of the order of 60 hours. The MiG-23MLD's sensor suite also incorporates the under-nose TP-26-Sh Infra-Reel Search-and-Track (IRST) sensor, which can be useful for emission-free tail-on intercepts, particularly as a back-up sensor should the radar be rendered inoperative by heavy jamming or technical failure. The IRST, however, has a somewhat limited search performance due to its restricted field of scanning - only 60° in azimuth and 15° in elevation. The average low-level detection range against receding fighter-size targets (in tail-on aspect) with afterburner on, is said to be more than 6nm (11km), though at high level detecting range it increases to 13nm (25km).

The MiG-23MLD is equipped with the SPO-15LE Beryoza Radar Warning Receiver (RWR). This is an analogue device, developed in the early to mid-1970s, capable of providing 360° coverage in azimuth and 30° in elevation. It has the capability to provide precise angular warning of radiating targets attacking in the forward hemisphere, although accuracy is much lower in the rear sector. The SPO-15LE is claimed to be sensitive enough to warn the pilot of the presence of an adversary's radar and the probable type and mode of its operation. On the other hand, the manual states that the RWRs used on Western fighters usually have 360° coverage in azimuth and 60°-80° in elevation. As a rule, the Western systems are sensitive and 'smart' enough to give timely warning of the MiG-23MLD's radar emissions as their detection range is considerably better than that of the radar - capable, for instance, of detecting an approaching MiG-23MLD with its radar emitting in search mode at distances of over 60nm (110km).

Unlike its main rivals, the MiG-23MLD lacks an integrated or pod-mounted ECM (electronic counter measures) system for self-protection - a great disadvantage in combat against the F-15A, F-16A, F-4E and the Kfir C.2, which all boast state-of-the-art ECM gear. The only self-protection gear on the MiG-23MLD is the PKiBP-23 (KDS-23M) chaff/flare dispenser comprising two six-round downward-firing units built-in to the centreline pylon. The VVS-FA *Flogger-Ks'* self-protection is enhanced by two BVP-50-60 50-round chaff/flare dispensers mounted in long slim housings on top of the centre fuselage. Syrian MiG-23MLDs received additional chaff/flare dispensers, (probably installed in the mid/late 1980s) installed on the rear fuselage.

One of the major advantages of the MiG-23 in

A valuable component of the* Flogger's *weapons suite, the infrared-guided R-24T (AA-7a Apex) is normally carried under the port wing glove of the MiG-23, with the semi-active radar-guided R-24R on the equivalent starboard pylon. The AA-7's high-altitude maximum range in a head-on engagement is 7nm (12km), increasing to 12nm (20km) in a tail chase. Mounted on the fuselage pylons of this Bulgarian Air Force* Floqger-B, *the R-60 (AA-8* Aphid;, *along with the AA-7, gives the MiG-23 pilot a combination of AAMs which was regarded by the Russians as ensuring that he could hold his own against all types of enemy fighters.

Having an overall performance comparable with that of the McDonnell Douglas F-15A's AIM-7F Sparrow, the R-24R (AA-7b* Apex; *semi-active radar homing (SARH) missile confers a degree of BVR capability on the MIG-23MLD. Russian missile experts claim that the monopulse seeker head of the R-24R provides good ECM resistance, although this advantage is now likely to have been negated by the newer generation of ECM systems used by potential adversaries.

The most obvious external difference between the MiG-23ML Flogger-G and MiG-23MLD Flogger-K to the latter's 'dog tooth' notch created in the wing root of the fixed portion of the wing, where it meets the side of the air intake. Described in Russian as a 'lambda' wing root extension (lyambda-naplyv) because its shape loosely resembles the Greek letter I, the 'dog tooth' notch helps to energise the airflow over the inboard section of the wing, delaying the stall at high angles of attack. This, in concert with the SOS-3-4 system, which automatically extends the leading-edge slats at critical angles of attack, gives the MIG-23MLD better stall and spinning protection and improved high-Alpha handling characteristics. Also noteworthy are the two large BVP-50-60 chaff and flare dispensers which equipped most Russian Flogger-Ks. The missile shown here is the AA-12 Adder, mounted for trials purposes. KEY COLLECTION

MiG-23MLD (Export), F-4E, F-15A and Kfir C.2 comparative characteristics and performance as given in the *Aide-Memoire for* ***the MiG-23 Pilot on Air Combat vs F-15A, F-16A, F-4E and Kfir C.2 manual.***

Figure	MiG-23MLD	F-4E	F-15A	F-16A	Kfir C.2
Typical TO weight	30,800lb (14,000kg)	45,8001b (20,800kg)	41,4401lb (18,800kg)	23,1001lb (10,500kg)	23,500lb (10,670kg)
Maximum speed at sea level	755kts (1,400km/h)	755kts (1,400km/h)	782kts (1,450km/h)	755kts (1,400km/h)	755kts (1,400km/h)
Maximum speed at altitude	1,351kts (2,500km/h)	1,270kts (2,350km/h)	1,325kts (2,450km/h)	1,135kts (2,100km/h)	1,260kts (2,330km/h)
Service ceiling	60,800ft (18,600m)	57,200ft (17,500m)	62,130ft (19,000m)	58,800ft (18,000m)	55,600ft (17,000m)
Thrust-to-weight ratio at typical TO weight	0.88	0.78	12	11	0.76
Wing loading at typical TO weight	88.29lb/sqft (430kg/sqm)	88.29lb/sqft (430kg/sqm)	68.78lb/sqft (335kg/sqm)	75.97lb/sqft (370kg/sqm)	62.62lb/sqft (305kg/sqm)
G-limit	+8.5	+7.3	+8.0	+9.0	+6.5
Max rate of climb	44,290ft/min (225m/s)	39,370ft/min (200m/s)	55,118ft/min (280m/s)	48,228ft/min (245m/s)	34,645ft/min (176m/s)
Time for Acceleration from 324 to 594kts (600 to 1,l00km/h) at 3,000ft (1,000m)	19.8s	22.0s	14.0s	16.0s	22.0s

Note: Thrust-to-Weight Ratio is given for bench-test conditions.

BVR COMPARISONS

BVR missiles comparative characteristics and performance as given in the *Aide-Memoire for the MiG-23 Pilot on Air Combat vs F-15A, F-16A, F-4E and Kfir C.2* manual.

	R-23R/T	R-24R/T	AIM-7E-2	AIM-7F
Maximum launch	8nm (14km)	9nm (17km)	8.7nm (16km)	9nm (17km)
range **at low level**	2.2nm(4km)	2.2nm (4km)	2.2nm (4km)	2.2-2.7nm (4-5km)
-forward quarter	6nm (11km)	6nm (11km)		
- rear quarter	2.2nm (4km)	2.2nm (4km)		
Maximum launch	13.50nm (25km)	19nm (35km)	13.4nm (25km)	22-27nm (40-50km)
range at high level	4.3-5.4nm (8-10km)	11nm (20km)	5.4nm (10km)	8-11nm (15-20km)
- forward quarter	6nm (11km)	6.5nm (12km)		
- rear quarter	4.3-5.4nm (8-10km)	10.8nm (20km)		
Minimum launch	2.2-3.3nm (4-6km)	1.4nm (2.5km)	2.2nm (4km)	1.4nm (2.5km)
range at low level	0.7nm (1.3km)	0.3nm (0.5km)	0.3nm (0.5km)	0.3nm (0.5km)
- forward quarter	2.2nm (4km)	1.4nm (2.5km)		
- rear quarter	0.7nm (1.2km)	0.3nm (0.5km)		
Maximum-g	4	7	5	7
of the launch aircraft				
Maximum-g	5	7	5	7
of the target				

Above: ***Russia has 'led the field' for many years in the exploitation of infrared search and tracking (IRST) systems on its interceptors, as an adjunct to radar, and the MiG-23 family was the first to use this technology on a wide scale. The seeker head of the TP-26-Sh IRST is mounted under a black-painted panel which provides a neutral background against which the cooled IR sensor can operate with maximum efficiency.*** TIEME FESTNER

combat with the F-15A and F-4E is its compact appearance and relatively small size, along with the fact that the wings are set at a 72° swept angle for high-speed flight. Combined with suitable camouflage, this would make low-level visual detection and tracking very difficult, particularly from above and in head-on encounters.

Weapons

The manual's authors claim that the MiG-23MLD's R-24R (AA-7 *Apex)* BVR SARH missile has a range of performance comparable to that of the F-15A's AIM-7F Sparrow, while the IR-guided R-24T and R-23T are a valuable addition to the *Flogger's* weapons suite. The R-24T's high-altitude maximum range in a head-on attack is 7nm (12km) and the figure increases to 12nm (20km) in tail-on engagements. At the same time, the manual claims that the 'Foxtrot' and 'Echo-2' Sparrow variants are known to have inferior ECM resistance compared to the R-24R; it also concludes that the US BVR missiles are not particularly effective in shoot-down engagements. The MiG-23MLD's R-23R and R-24R missiles, on the contrary, boast modern monopulse seekers with good ECM resistance. In 'real world' air combat, however, it would not be impossible for their 'lock-on' to be broken by 'smart' jamming from an enemy fighter's new-generation ECM gear. The ranges of the MiG-23MI_D, F-15A and F-4E BVR missiles are shown in Table 3 Figure 2.

The AIM-9L Sidewinder which arms the F-15A and F-16A, with all-aspect lock-on capability, is considered to be the best Within Visual Range (WVR) missile, according to the manual. On the other hand, the MiG-23MLD's R-60 and R-60MK (AA-8 *Aphid)* purpose-designed dogfight missiles are quoted as capable of head-on lock-on, although only if the target's afterburner is on. The R-60MK has, in general, similar launch limitations and an equally sensitive cooled seeker head as the AIM-9L, although with much shorter range. The R-60 and R-60MK have a decisive edge in the minimum launch range - as little as 750ft (250m) compared to the AIM-9L's minimum of 1,500ft (500m). It has to be said that one notable omission by the VVS and/or the KGB/GRU intelligence authorities was that nothing on the performance and employment details of the Rafael Python 3 all-aspect missile was included in the manual. This was the preferred close air combat weapon of the Israeli F-15AS and credited with 35 kills in June 1982.

It should be remembered that the Launch Acceptable Region (LAR) in the horizontal plane of the close air combat missiles - as given in the manual (see *Figure 3)* - can only be considered valid for a non-manoeuvring target, flying at 16,000ft (5,000m) at military power, with both the target and the attacking fighter maintaining a speed of 485kts (900km/h). If the target is turning, the LAR shrinks considerably.

The MiG-23MLD's Sapfir-23MLAE-2 radar has a useful close air combat mode (a significant omission on the previous Sapfir-23 variants), with vertical scan in a tall 'window', perpendicular to the aircraft's longitudinal axis, with a field of 45° in elevation and 6° in azimuth. In this mode, the radar locks semi-automatically onto the first target to enter the 'window' at distances of between 0.17 and 5nm (0.3 and 9km). This is useful in high-g manoeuvring situations as the radar sends commands to slave the R-60, R-60MK and R-13M seeker heads toward the acquired target.

The manual concludes that the built-in guns of all the fighters compared have approximately equal overall efficiency, in terms of useful range and lethality, for use against fighter-size targets. In addition, it states that the lead-computing optical sights of the MiG-23MLD and its opponents have approximately the same accuracy in the gun-aiming mode.

Conclusions and BVR Considerations

The manual concludes that the MiG-23MLD(Export), armed with the R-24/R-60MK AAM combination, could be considered reasonably capable of holding its own against all types of enemy fighters. However, it could gain the edge over the F-15A - the most capable of its rivals - only through multiple simultaneous 'slash-and-dash' attacks by several aircraft from different directions and from long range. These would have to be mounted in a decisive manner and would involve a high degree of co-ordination between the groups once the WVR phase was entered into, and there would have to be a timely exit from combat.

Above: ***The almost central location of the BVP-50-60 chaff and flare dispensers on the fuselage can be appreciated in this view of a MiG-23MLD taxiing past one of the hardened aircraft shelters at Altes Lager.*** TIEME FESTNER

Perhaps the most important point in the chapter on BVR combat deals with the importance of the initial attack: "In order to achieve surprise in shooting, MiG-23MLD pilots should exploit all of their [accumulated] experience and aggressiveness in the first attack." This is considered a critical factor, as the element of surprise has proved to be nine-tenths of air combat success, both offensive and defensive. High-speed, highly agile fighters such as the MiG-23 have the option of engaging or disengaging at will, even in the all-aspect BVR and WVR missile environment which typified 1980s and 1990s air combat.

Other critical elements in the success of a fighter sweep or CAP (Combat Air Patrol) operation are the command, control and communications (C^3) aspects of the defending fighter force. According to the Soviet doctrine of the 1980s - believed to be still in use today within the MiG-29 and Su-27 communities - GCI controllers had virtually 'absolute authority' to dictate every action in the control of their own fighters. This would include 'fighter sweep' and CAP operations in friendly, disputed or enemy airspace, including selection of heading, altitude, speed, authorisation of attack and missile firing, 'bugouts' (disengagements), etc. Air superiority operations require well-honed GCI (Ground Controlled Interception) to make up for the lack of AWACS (Airborne Warning and Control System) assets and the Soviets perfected this concept in the Central European theatre where a dense network of multiply-redundant ground-based surveillance radars was available.

When keeping a lookout for enemy fighters, *Flogger* pilots were strongly advised to carry out a visual search from take-off to landing - another important lesson derived from close analysis of the Bekaa Valley clashes. Reliable GCI assistance was not available here and Syrian pilots were left to fly 'blind' until engaging the enemy in close combat encounters in the Bekaa Valley, which usually turned out to be something of a 'turkey shoot' for the Israeli fighters.

In order to expand the search zone in a high-threat environment, the *Flogger* pilot was required to fly a 'weaving' or zig-zag flight profile, with his attention focused on a visual search pattern below the lower limits of his own forces' ground radar coverage, (usually below 1,000ft [300m] in Central Europe in the 1980s). However, it is well known that MiG-23 pilots had problems with the rearward and downward field of view, as the fighter was designed with a low-drag canopy faired into the fuselage, although the canopy-mounted rear-view mirrors expanded the rearward field of view to some extent. Consequently, during low-level sorties, the *Flogger* pilot had a great deal of difficulty in keeping a turning 'bogey' in view, or during a visual search below his aircraft and pilot workload was excessively high in this mode of flight. On the other hand, the MiG-23MLD has fast acceleration - thanks to a low-drag airframe and the aerodynamic qualities of the fully-swept wings - and its high speed could make it more difficult for an unseen attacker to satisfy his aiming requirements in the consequently reduced intercept time. This aspect of *Flogger* operations could be another defensive factor when flying in enemy or disputed airspace.

During BVR combat, the manual emphasises that attacks should not be initiated without offensive advantage and the prospect of firing the 'first shot'. The general rule: *'Who shoots first - kills first and dictates the outcome of the engagement'* should be seen as a particularly important dictum for the MiG-23 community. If the MiG-23 was dictating the outcome of the engagement, the aircraft could exploit this advantage to the full, using the 'slash-and-dash' attack technique - the preferable method, and often the only one available against F-16s and F-15s.

Above: ***The cockpit of the** MiC-23MLD **can be regarded as typical of Soviet design standards of the 1970s, crammed with instruments and switches which imposed a fairly high workload on the** pilot. **The** **Flogger** **can only be effective in combat if flown by pilots with above average flying and tactical skills.***

If an unknown type of 'bandit' is encountered, it should be assumed that it is an F-15 - the most capable and hence the most dangerous, enemy fighter. The manual stresses that the MiG-23MLD is prohibited from closing head-on with any such adversary, as these may well be F-15s with better radar performance and longer-range BVR missiles. For this reason, one piece of advice that the manual directs specifically at GCI officers is that during fighter sweep operations it would be strictly against the rules for them to vector MiG-23s in head-on attacks against non-identified bandits. However, if such a situation is unavoidable, then the tactics recommended to MiG-23 pilots and GCI officers are as follows: "If the distance to the 'bandits' exceeds 12nm (20km), the MiGs should immediately make a sharp turn away from the target, descending and pulling high-g and then reverting to a 'side-on' or 'tail-on' missile attack. If the target is detected side on, the MiG-23MLD pilot should use chaff and turn away sharply in order to evade the Sparrow missiles, and then revert to attack."

In order to mask a group attack, the manual recommends that own forces' fighters be flown in carefully spaced formations. These are usually known as 'cells' - virtual square 'boxes' of airspace with 1,200ft-long (400m) sides, within which enemy airborne radars are incapable of discriminating the presence of multiple targets. (However, this is only valid for earlier PD [pulsed Doppler] radars without the raid cluster resolution mode introduced in the mid/late-1980s.) In other words, a group **of** aircraft would be displayed as a single target on an airborne radar display at a distance of more than 8nm (15km). When tracked by enemy radar, all the aircraft within a 'cell' would then execute simultaneous manoeuvring (the so-called 'burst' manoeuvre) in the horizontal and vertical plane, in order to break lock and initiate a massed attack.

In a 'real world' situation there would always be the chance that a BVR missile launched at the maximum permissible range might be out-manoeuvred by the enemy. Consequently, in a head-on attack, the advice is for the first R-24R (R-23R) to be launched at 90% maximum range (below 6nm [11km] at low level and 15nm [28km] at medium/high level). The second should follow at 60-70% maximum range (below 4nm [7.5k] and 10nm [20km] respectively). If the R-24T infrared homing missile is available for use against enemy fighters without a known BVR capability (i.e. F-16A and Kfir C.2) the *Flogger* pilot should delay launch to the minimum permissible range, typically below 5nm (9km). Immediately following the R-23R/R-24R launch, the MiG-23 is allowed to change course by up to 30°. The target should still be kept within the radar's gimbal limits, with a subsequent breakaway in a 3-g descending turn until missile impact and a sharp reduction in the closing speed relative to the target. Ten to 15 seconds after the break, the manual recommends the pilot to accelerate again in order to gain the energy necessary for the close air combat that may follow. The R-24T is a genuine 'fire-and-forget' weapon, and after launch, the pilot is advised by the manual to carry out immediate missile-evading manoeuvres in the form of a high-g roll as he progresses to a possible WVR engagement.

WVR Combat Considerations

Close air combat recommendations, as given in the manual, sound even more interesting than those for BVR encounters. They begin by reminding the pilot to constantly monitor his fuel state during the engagement as low-level flight with afterburner results in a fuel burn of 88 Imp gallons (400 litres) per minute. The MiG-23MI_D is most effective in high-speed air combat, with one attack run - or two at the most - keeping manoeuvring to the minimum. As a rule, the difference in manoeuvring performance and pilot training level between fighters engaged in close air combat becomes increasingly evident in follow-on manoeuvring after the first attack. If the 'bandits' are on the offensive, the manual recommends the MiG-23MLD pilot to initiate defensive manoeuvring as soon as possible, accompanied by flare release (not a good idea if the afterburner is on!). If it is attacked from the rear, the MiG-23 is said to be perfectly capable of evading the attacker simply by out-accelerating it. The manual advises that the R-60 and R-60MK dogfight missiles be used at distances of between 900ft and 4,500ft (300m and 1,500m). The R-13M is useful at between 3,000ft and 6,000ft (1,000m and 2,000m), and the GSh-23L twin-barrel gun is considered lethal when fired below 1,200ft (400m).

The manual assures MiG-23 pilots that the F-15A or F-16A have no valuable advantage in their close air combat weapons. However, these US new-generation fighters are regarded as being much more manoeuvrable, and could consequently achieve a weapons employment solution in their turning engagements much easier and earlier than the MiG-23MLD. In view of this, MiG-23MLD pilots are strongly advised that prolonged turning engagements against F-15As and F-16As, both offensive and defensive, should be avoided by all means. Attack manoeuvring should be broken off at the latest by the end of the first minute of the engagement if no weapon employment solutions have been achieved by then. The manual also advises the pilot to maintain high speed (not below 485kts [900km/h]) during combat as the lower the speed, the greater the 'bandit's' manoeuvring advantage. Manoeuvres which would cause considerable loss of speed - and therefore energy - are permitted only when necessary for weapons employment or missile evasion. MiG-23MLD pilots are advised to avoid any turning combat in the horizontal plane vs the Kfir C.2.

Real World Limitations

The MiG-23MLD (Export) had many shortcomings inherited from the MiG-23MF/ML: vicious high-AoA (Angle of Attack) handling characteristics, slow roll and pitch stick response, unimpressive pitch and roll rates and unsatisfactory turning performance in both the vertical and horizontal plane at high subsonic and transonic speeds with the wings set at 45° swept position. However, some of these were eliminated on the VVS-FA's top-notch MiG-23MLD by a range of improvements in aerodynamic and flight control systems. Vortex generators were mounted on the pitot boom, and notched leading edge roots were introduced to act as vortex generators to energise the flow over the wings, in order to delay the stall. The upgraded flight-control system incorporated the SOS-3-4 synthetic 'stick-stop' or the so-called soft pitch/AoA limiter (borrowed from the MiG-29), which restricts g, angle of attack and pitch rate. As a result, the aircraft's agility was considerably better than that of its predecessor, and it had far better stall/spinning protection and acceptably good high-Alpha handling qualities (this particular aspect, together with pilot visibility, was among the main shortcomings of the MiG-23M/ML, limiting its performance in manoeuvring air combat. Despite tests on the MiG-23MLD, there were no production-converted *Flogger-Ks* with built-in SPS-141 Siren or Gardenya-1FU active jammers.

The various MiG-23 upgrades offered by the Mikoyan Design Bureau in the mid and late-1990s - including a new fire control system, new radar and the R-77 (AA-12 *Adder)* active radar homing missile and glass cockpit - have proved a far-from-cost-effective solution for most of the existing operators, deprived of the funds and the determination to launch such programmes. Most, if not all, existing *Flogger-B/G* operators have little or no capability to procure new equipment, for economical or political reasons. These countries (such as Algeria, Libya, Syria etc.), may go ahead, however, - or may have already done so - in increasing the combat capability of their MiG-23MFs and ML/MLDs at low cost by integrating the R-73 high off-boresight missile. This enables the pilot to acquire and engage an enemy aircraft even at a high angle (up to 45°) off his aircraft's heading. The missile was introduced on the VVS-FA MiG-23MLDs as early as in 1983, and integrated by replacing three black boxes in the aircraft's fire control system. To fully exploit the R-73's high off-boresight capabilities, however, would require a helmet-mounted cueing system (HCMS), similar to that adopted for the Indian Air Force MiG-21-93. There are various sources in Russia, Ukraine and Belarus' - both government and private companies, often operating on the 'grey' and the 'black market' - from whom new or second-hand R-73s may be procured.

With the relatively inexpensive airframe/systems service life extensions offered by the Mikoyan Design Bureau, the MiG-23MI_/MLD(Export) manufactured in the early 1980s could soldier on in Syria, Cuba and North Korea for another 25 years and they could serve well into the mid- and late-2OOOs.